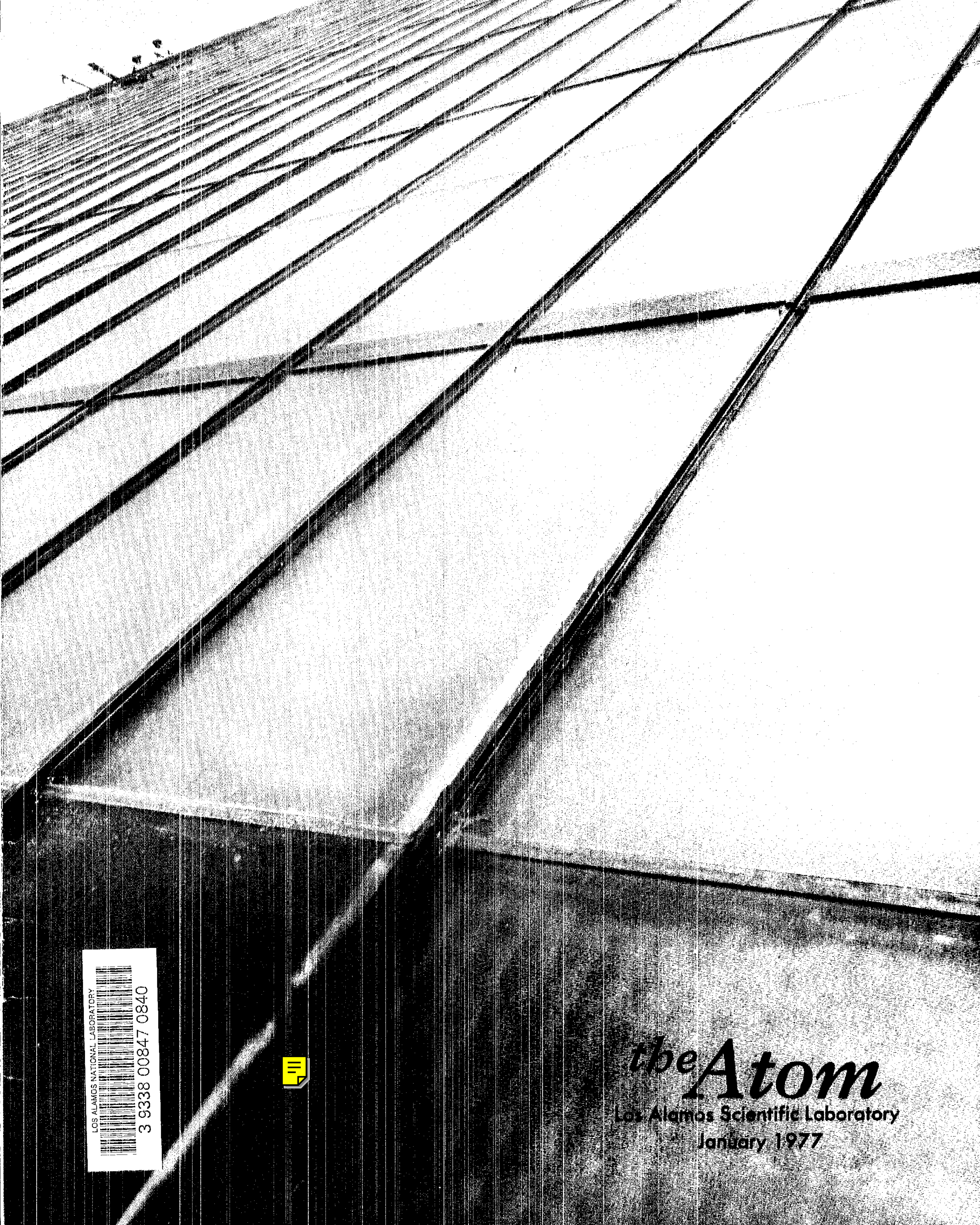

the Atom

Los Alamos Scientific Laboratory

January 1977

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FRONT AND BACK COVERS

Bill Jack Rodgers and Johnnie S. Martinez contributed the cover and back cover photos for the January Atom. Bill Jack's cover photo catches workers perched at the top of the solar panels on the soon-to-be-completed National Security and Resources Study Center. Johnnie, while traveling to an assignment at Fenton Hill, took the picture of the ice-coated tree for the back cover.

EDITOR'S NOTE

With this issue, the Atom is reverting to its previous printing schedule of 10 issues a year.

Directly For First Time

Fuel Pin Image Photographed

By Barb Mulkin

Two scientists in the Los Alamos Scientific Laboratory's neutron measurement group have performed an experiment, counted a spinoff from weapons diagnostic work, that illustrates the value of the adage: "One picture is worth a thousand words."

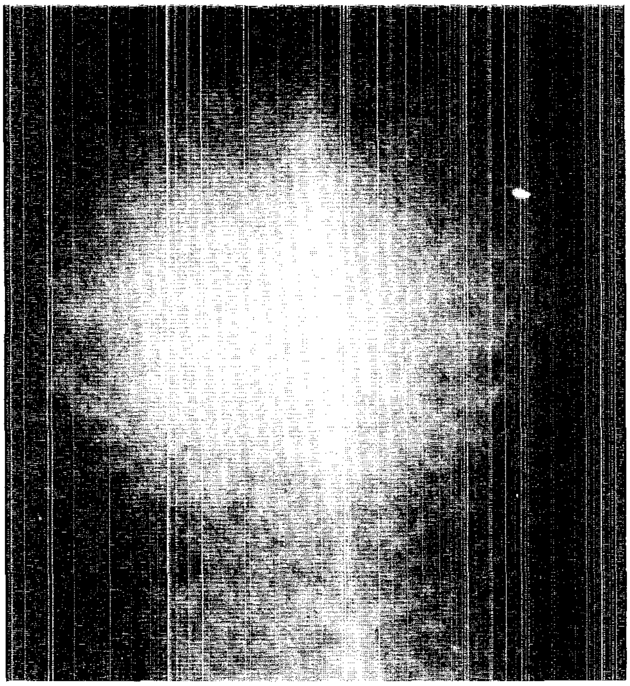
George Berzins and Ki Han, both J-12, used neutrons and gamma rays emitted by a fuel pin in a test reactor to photograph directly, for the first time, the image of the pin as it was heated to destruction.

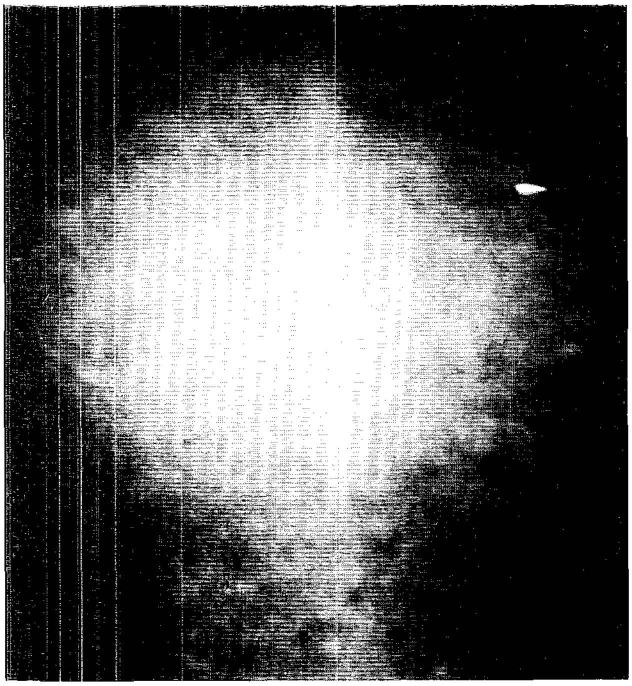
J-12's experiment is viewed as a diagnostic tool to help technologists increase the safety of nuclear power reactors. It is expected to yield invaluable data in many areas, such as fuel pin design.

Performed at the TREAT (Transient Reactor Test) Reactor operated by Argonne National Laboratory at Idaho Falls, Idaho, the experiment is named PINEX (for pinhole experiment) and is based on a technique used in the nuclear weapons testing program at the Nevada Test Site (NTS). It was conducted primarily to calibrate the equipment, because, as the researchers point out, the concept of using pinholes for reactor core studies "has been around for at least 15 years but has been rejected, primarily because it was felt that existing instrumentation did not have adequate sensitivity." If this is true, then the PINEX experiment successfully completed last September may be a milestone in the quest for improved reactor safety.

Reactor design in the United States and most other countries employs a "defense-in-depth" philosophy, according to M. G. Stevenson, R-7, reactor safety analysis and modeling group leader. Stevenson explains that this philosophy calls for reliability of normal operation of the reactor so that malfunctions will not occur, for protective features that prevent damage to the

The white line in the center of the photo at left shows about 4 inches of the fuel pin (¼-inch in diameter) just before it is heated to destruction in the test reactor, and at right is a view of the pin (now about ⅜-inch in diameter) just after it is heated to failure. The less-bright area is caused by background radiation from the reactor core. The light signals picked up by the camera were produced as the flux of fission neutrons emitted by the plutonium-oxide fuel test pin passed through the pinholes onto a plastic scintillator that converted the radiation signals into light signals. A mirror assembly was used to reflect the light onto the lenses of 2 ultrasensitive cameras that would have been impaired by direct radiation. The pin destruction was recorded on videotape, from which these photographs were made.





plant (including prevention of release of radioactivity even if severe malfunctions do occur), and for additional margins and measures that protect the public against unforeseen circumstances.

In a nutshell: "The main business of reactor safety is prevention of damage to the nuclear fuel pins and the release of radioactivity to the environment," Stevenson says.

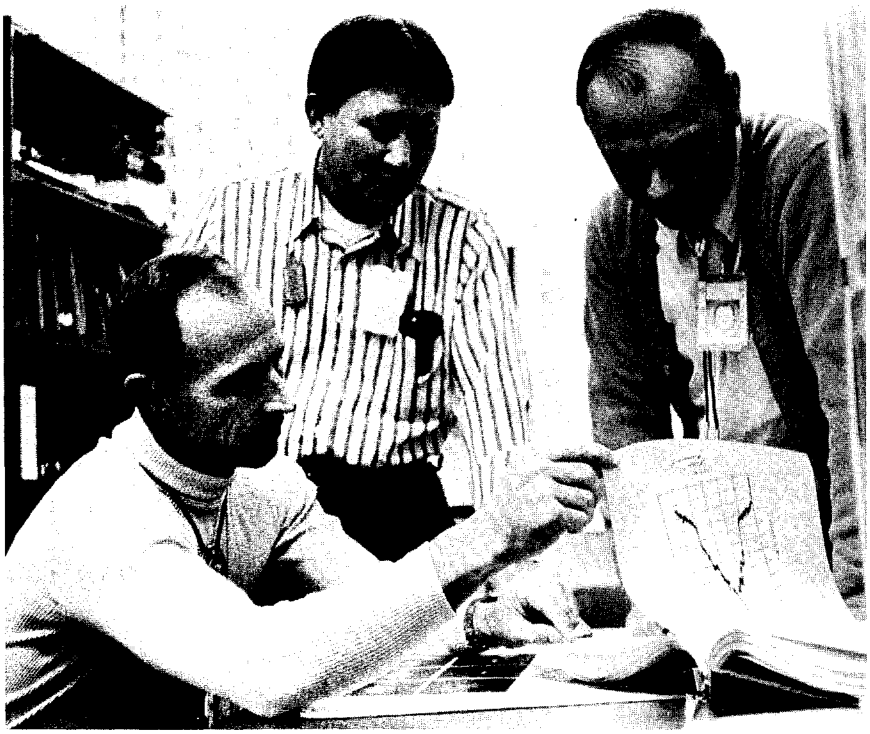
The nuclear power industry has an enviable safety record, understandable since safety has been a prime consideration of both government and industry since the first U.S. commercial nuclear power was generated almost 21 years ago at the Shippingport Atomic Power Station—a joint venture of the U.S. Atomic Energy Commission and the Duquesne Light Company. Since then, the nation's 57 operating power reactors have compiled a safety record of 250 reactor years (and 680 billion kilowatt hours) of operation without a major accident. But the search for improved design and more efficient monitoring systems, which began before construction of the first plant, goes on.

With a new generation of nuclear reactors, the LMFBRs (Liquid-Metal Fast Breeder Reactors), waiting in the wings, the search has diversified. The fast-breeders promise to alleviate our energy problems by producing more plutonium fuel than they consume, but they present new areas for research in safety technology.

Berzins and Han say that before pursuing the experiment they examined in considerable detail the potential for adapting the PINEX technique to viewing the transient behavior (rapid rise in the neutron flux leading to increased heat and pressure) of a test fuel pin in the core of a reactor.

Time for the experiment was booked on the TREAT reactor, and an intense effort to complete design and fabrication of the PINEX equipment began. Involved in fielding the experiment, in addition to Berzins, Han, and project manager Bill Roach, were Tom

Tom O'Hare, left, and Craig Pickett, both J-12, examine an ultrasensitive television camera used recently in videotaping the image of a fuel pin as it was driven to destruction in the Transient Reactor Test (TREAT) Reactor operated by Argonne National Laboratory at Idaho Falls, Idaho. The black box on top of which the men are working was placed in the reactor room and housed the television cameras and scintillator.



Bill Roach, sitting, J-12 group leader, Ki Han, center, and George Berzins examine data collected in the PINEX (pinhole experiment) at Argonne National Laboratory's TREAT reactor.

O'Hare, left, and Pickett inspect the scintillator which converted the neutron image into an optical image viewed by the cameras.

O'Hare, Craig Pickett, Al Widman, Steve Jaramillo, and Joe Calligan, J-12; Charles Renz, R-5; and Ron Cosimi and Bob Kennedy, J-7. Assisting with analysis of data from the experiment are Sam Donaldson and Bill Wheat, J-12; Dick Kruger, M-8; and Dan Carrol and Mike Turner of EG&G.

"We had only about 3 months to ready the equipment before taking the PINEX assembly to Idaho," Han says. "The LASL Shop Department coordinated fabrication of the pinhole block, and it fit perfectly when inserted into the shield wall of the reactor—quite a feat."

To view the fuel pin, which was provided by the Hanford Engineering and Development Laboratory, 3 parallel pinholes (apertures in long, tapered collimators) were embedded into a block that was inserted into the south wall of the test reactor. The tapered pinhole design followed criteria established in experiments at the NTS.

The flux of fission neutrons emitted by the plutonium-oxide test-pin fuel passed through the apertures onto a plastic scintillator that converted the radiation signals into light signals. The disk fluoresced in proportion to the number of neutrons striking its surface.

A mirror assembly was then used to reflect onto the lens of 2 ultrasensitive cameras that would have been destroyed by direct radiation.

"Imaging techniques such as these may prove to be a tremendously useful approach to studying fuel pin design," Berzins says. "We were particularly pleased with this experiment. The equipment was calibrated and demonstrated adequate sensitivity, and second, useful information on the fuel pin itself was obtained."

PINEX Experiments Viewed As Springboard

During the experiment, a series of photographs was recorded on videotape in real time with an intensified television system—a constant imaging of the fuel pin as it was driven to destruction. A live display of the process was viewed in the TREAT control room.

Data from the September experiment are still being processed, and Han and Berzins say the single pinhole experiment will be repeated at TREAT next April, but expanded through the use of more sophisticated electronic instrumentation to refine the technique. They view the PINEX experiments as a "springboard for a coded aperture experiment" that is scheduled late next summer.

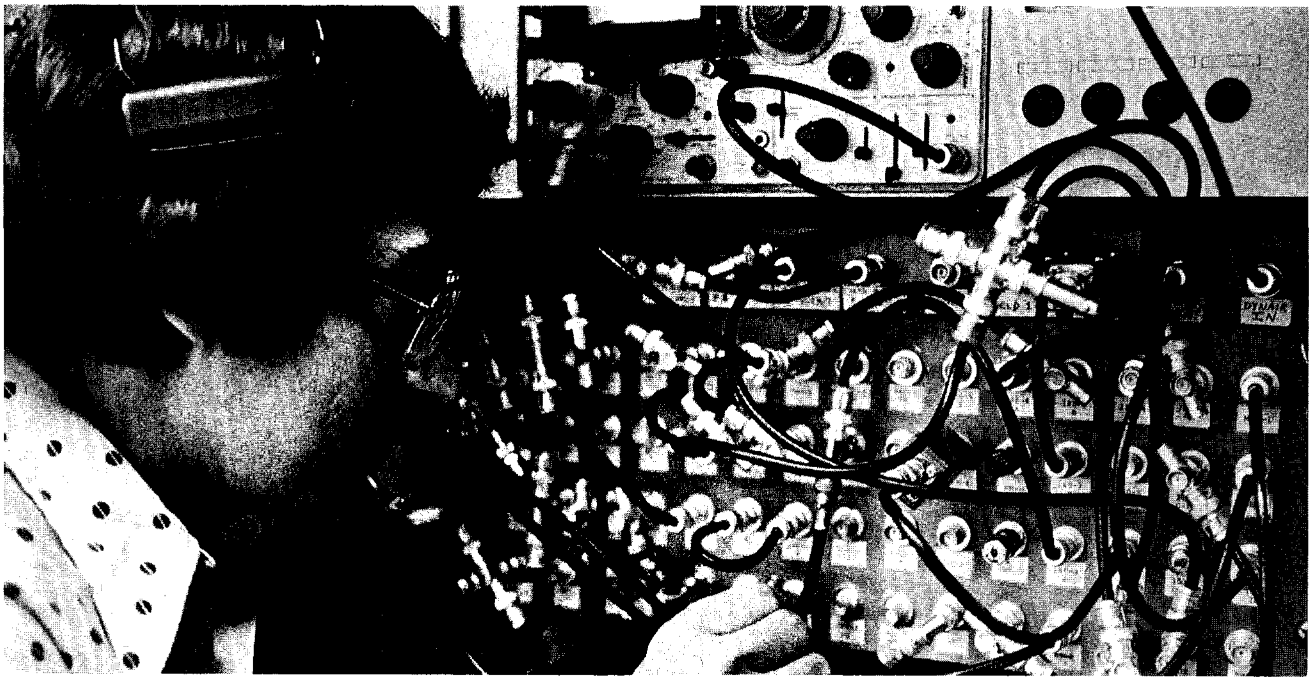
The coded aperture experiment J-12 plans will use a nonredundant pinhole array (NRPA), which has the potential for providing 3-dimensional pictures of a fuel pin under stress. It will be carried out using essentially the same block equipment as the single pinhole experiment.

Han says the multiple images that would result from a carefully designed configuration of 15 pinholes incorporates "pseudo-holographic" techniques.

"Essentially, coded aperture experiments provide multiple images. Their resolution is restored through well-known reconstruction techniques," Han explains, "but the 2 main rewards of such an experiment are the increased efficiency—the ability to view very dim sources—and, of course, the 3-dimensional property of the restored image of the object (pin)."

Multiple images of a fuel pin obtained through a coded aperture array could yield remarkable information on the material properties of both a fuel pin and its fuel, on the ability of various components to resist a high-power transient, and on the point of stress at which failure becomes inevitable.

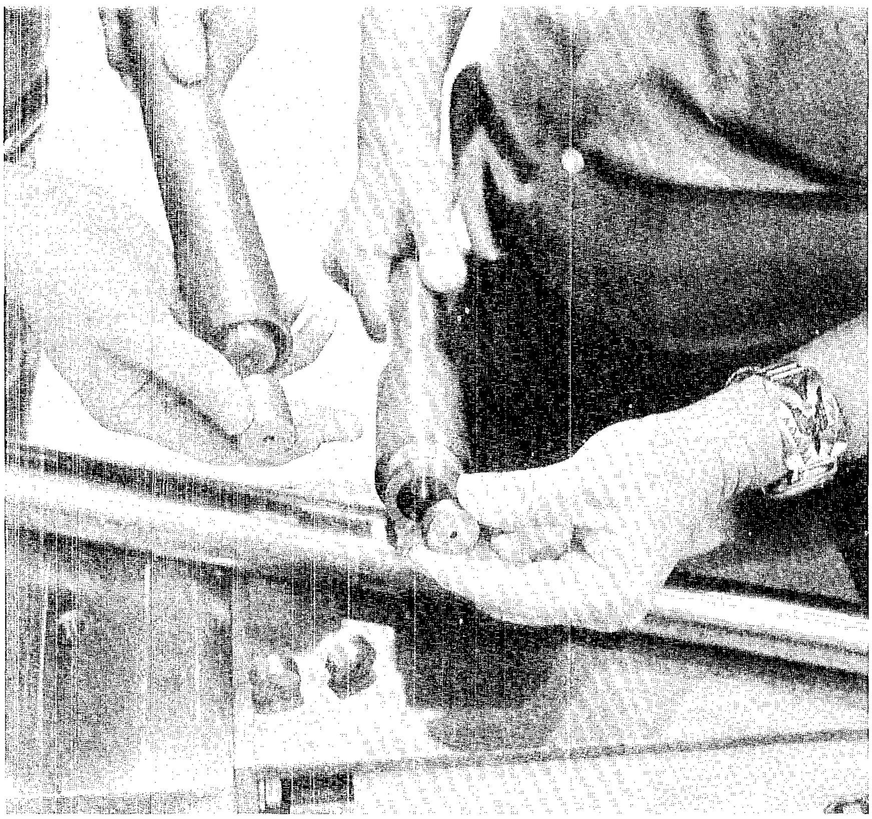
The success of the PINEX experiment has encouraged J-12 scientists to feel that the potential for efficient data collection using coded aperture techniques exists. However, they caution that both PINEX and future nonredundant arrays



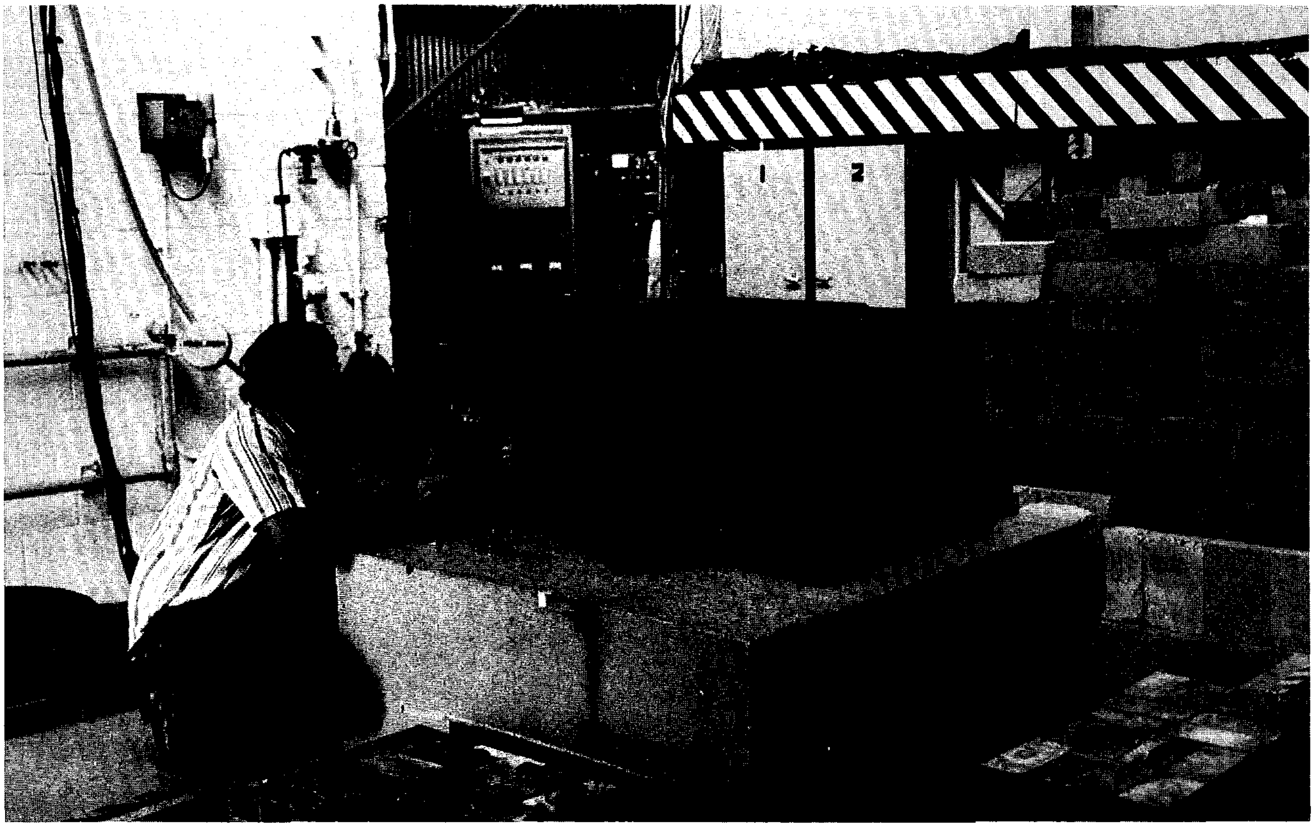
Pickett connects signal cables for camera and recording equipment at the console in the J-12 trailer used in the experiment at the TREAT reactor.

O'Hare prepares to put videotape on a recorder in the console.

Ron Cosimi, left, and Bob Kennedy, both J-7, inspect and assemble one of the small aperture (pinhole) tubes to be inserted in the pinhole block, which is attached to the outside of the reactor wall. The block holds 3 tubes, which projected the neutrons emitted by the fuel pin inside the reactor onto the scintillator.



Cosimi and Kennedy place slugs, or inserts, into the pinhole tubes.



Pickett works on one of the cameras in the experiment area outside the TREAT Reactor at the Idaho National Engineering Laboratory. (Photo courtesy of Argonne National Laboratory).

are still only diagnostic tools: "There is a lot of difference between conducting an experiment such as this under carefully controlled conditions with a single pin," they point out, "and applying such a technique to monitoring an operating reactor.

Today's reactors operate on uranium fuel contained in thousands of slender pins, or rods, assembled in bundles to form a core. The core is immersed in liquid that transfers the heat of nuclear reactions to produce steam to drive turbines for the generation of electricity.

Fast-breeders will operate much as today's light-water reactors do, although there will be differences, chiefly in fuel consumption (LMFBRs will use a 20- to 80-percent ratio of plutonium-uranium fuel), core design, and coolant (water for pressurized and boiling water reactors and liquid sodium for fast-breeders).

Radioactive fission products are largely contained in the ceramic fuel pellets in all 3 types of power reactors, although some, mostly gaseous products, are retained in a gas space within the rods. If the cladding of the fuel pins is heated to several hundred degrees above normal operating temperature, it can be perforated and will release gaseous radioactivity, plus some solid fission products on the surface of the ceramic pellets, into the gas space. The reactor coolant and containment systems are designed to confine this material, and only severe overheating, sufficient to cause the ceramic fuel to melt, can lead to release of a substantial amount of the radioactive material.

Primary components of today's protection systems involve sophisticated devices for detecting faults, shutting down the reactor, and providing backup cooling capability. But in spite of these measures, an important part of the assurance of public protection is the analysis of accidents in which all, or part, of the protective systems are arbitrarily assumed to fail. Analysis of such accidents involves characterization of the phenomena and se-

PINEX Experiments Are Encouraging, But Method Still A Diagnostic Tool

Thousands Of Pictures Taken . . . Each Worth A Thousand Words

quences resulting from substantial fuel melting.

Sophisticated computer calculations provide valuable information on postulated accidents, but, ultimately, experiments are necessary that provide direct information on the behavior of reactor materials under transient conditions.

Such research and development work is ongoing in both R-Division and P-Division, in addition to the pinhole and NRPA experiments conducted in J-12. Two other major facets of such work involve hodoscope techniques and x-ray radiography.

The J-12 experiment was funded in part by ERDA's Division of Military Application through J-Division, and it is sponsored by ERDA's Division of Reactor Development and Demonstration. In addition, some parts of the PINEX experiment were funded and supported by the Nuclear Regulatory Commission through R-Division.

The painstaking research being carried out nationwide to explore improved reactor design and more efficient monitoring systems forms the building blocks on which the nuclear industry has built its safety record.

PINEX is a small part of that nationwide program, but it made a significant contribution with a series of pictures delivered in a fraction of a second. J-12 scientists feel every one of those pictures was worth a thousand words.

short subjects

Los Alamos Scientific Laboratory sponsors a series of 3-day courses throughout the United States for health and safety personnel who are responsible for establishing and maintaining respirator programs.

Personnel of the Laboratory's H-5 group have devised the courses on respiratory protection and Occupational Safety and Health Standards (OSHA) as they relate to selection, use, and maintenance of respirators.

Registration may be accomplished by contacting the LASL Respirator Training Center, Los Alamos Scientific Laboratory, Mail Stop 988, P.O. Box 1663, Los Alamos, New Mexico 87545.

AVCO Everett Research Laboratory, Inc., Everett, Massachusetts, has been awarded an $800,000 contract by the Energy Research and Development Administration to help develop laser concepts for laser-induced fusion, and will conduct a development program in support of a fusion experiment using carbon dioxide gas lasers at Los Alamos Scientific Laboratory.

LASL's L-Division is developing a large laser system with six 16-kilojoule laser firing in nanosecond (billionth of a second) pulses that compress and heat tiny deuterium-tritium pellets to release fusion energy. Each pulse would come from a chain of carbon dioxide gas lasers acting as amplifiers of a low-energy, nanosecond pulse from an oscillator laser.

PATENTS

O'Dean P. Judd, L-2, and **Bergen R. Suydam,** T-7, have been awarded a patent for a diffraction smoothing aperture for an optical beam. The invention presents an aperture adapted for use with optical beams, and in particular, laser beams, for smoothing diffraction-caused central and other intensity variations in beams passing through the aperture.

A paper submitted by **Gordon E. Hansen, Cleo C. Byers,** and **Jerry J. Koelling,** all R-5, has received the Best Paper Award by the Nuclear Criticality Safety Division at the American Nuclear Society winter meeting. The paper is entitled "Fission and Explosive Energy Release of PuO_2,PuO_2-UO_2, UO_2, and UO_3 Assemblies."

A new group, AP-4 (laser chemistry), was formed effective December 1 with **W. Dale Breshears,** group leader, **N. Roy Greiner,** alternate group leader, and **W. Burton Lewis,** associate group leader.

Bruce Dropesky, CNC-11, is chairman-elect for 1977 and will become chairman in 1978 of the Division of Nuclear Chemistry and Technology of the American Chemical Society.

Retirements: **James W. Myers,** WX-3, lead operator; **Morris J. Engelke, Jr.,** H-1, staff member and section leader.

Deaths: **Robert H. Sweet, Jr.,** DIR-SEC, chief, physical security.

LASL's Involvement In Scientific Exchange, Cooperation With Universities Is Expanding

Los Alamos Scientific Laboratory is spending about $3.5 million a year on programs of cooperation and scientific exchange with educational institutions and on educational opportunities for Laboratory personnel.

Director Harold Agnew is placing increased emphasis on LASL's interactions with universities, and additional support is likely for educational opportunities that are mutually beneficial to the Laboratory and the universities and that will further scientific knowledge for the benefit of people everywhere.

Since the Laboratory's first efforts soon after World War II to work with the University of California and the University of New Mexico to establish educational opportunities for Laboratory employees, the number and extent of educational programs have grown steadily.

Changes in federal policies and the state of the economy have, in some years, limited availability of funding for LASL-university programs, but the interest of Laboratory personnel in working with universities has steadily grown.

LASL's administration in the late 1940's recognized the need for cooperation with educational institutions, and by the fall of 1950 arrangements were worked out with both the University of New Mexico (UNM) and the University of California to provide graduate courses in Los Alamos for Laboratory employees. By 1956, UNM formally proposed to cosponsor with LASL a graduate center at Los Alamos, and the University of California dropped its extension course offerings.

William H. Crew, as assistant director for scientific personnel, oversaw certain operations of the Personnel Department and the Laboratory in the new university area. During the mid-1950's and early 1960's, university relations was not regarded within LASL as a formal program, but rather as a policy of the Laboratory.

Education is mentioned as a main responsibility of the Laboratory in its contract with the Energy Research and Development Administration (ERDA), as it was with the Atomic Energy Commission (AEC), forerunner of ERDA.

Also being formed during the time of increased AEC interest in education were university consortia, such as Associated Rocky Mountain Universities (changed in 1967 to Associated Western Universities), which began working with national scientific laboratories in promoting educational interactions.

In the early 1960's, LASL established an Office of University Cooperation headed by Jerry Kellogg, who took over coordination of the expanding programs upon Crew's retirement.

Del Sundberg in 1966 became head of the Public Relations Department, and also assumed responsibilities for the Office of University Cooperation.

In 1970, after formation of the Information Services Department (ISD), headed by Sundberg, the Personnel Department was given responsibility for the programs previously supervised by the Office of University Cooperation, and Ted Dunn was named university relations coordinator. Sundberg, however, retained supervision of University Relations policy matters for a year or two, working directly with Agnew.

In 1971, Agnew invited administrators of New Mexico universities to LASL to discuss ways to expand cooperation between the Laboratory and the universities. An academic cooperation proposal was drafted based on LASL's offer to consider forms of academic cooperation involving its staff and facilities that fall outside existing programs such as the Clinton P. Anderson Los Alamos Meson Physics Facility (LAMPF) Users Group, AWU-supported individual researchers, and the Undergraduate Cooperative Programs.

Primarily, the academic institutions would propose projects and participants to the Director. Participants accepted by the Laboratory would stay for the time necessary to conduct their work, which would have to have elements of education, public benefit, and the like.

The increase in the number of participants in various programs at LASL continued through the early 1970's, but the number of programs and participants was reduced because of budget cuts during 1973-74.

Since 1975, with the advent of ERDA, there has been increased activity and emphasis in the variety and scope of programs and in the number of students doing their dissertations at the Laboratory.

LASL-university interactions presently are composed of the following programs:

- The Los Alamos Graduate Center of the University of New Mexico has been operated jointly by UNM and LASL since 1956 to provide graduate evening courses, primarily in science and engineering, for LASL personnel. About 24 courses are offered each semester, and the enrollment totals about 250. UNM has awarded 247 degrees, including 32 bachelors, 165 masters and 50 doctorates, to people who have taken a substantial number of courses at the Center.
- The Advanced Study Program, begun in 1953, provides an opportunity for selected LASL scientists to complete their university residence requirements for the Ph.D. Since the program's beginning, more than 80 people have participated at about 30 universities. Almost all of them returned to LASL to do their thesis work.

Since World War II, Many Programs Providing Educational Opportunities For LASL Personnel Have Been Created

- The Graduate Thesis Program is offered to regular Laboratory employees who have completed most of the course requirements for an advanced degree and who have a thesis proposal acceptable to LASL and their university. Since the program's inception in 1951, 131 participants have completed their requirements for advanced degrees (89 Ph.D.'s and 42 master's) granted by 32 universities.
- Professional research and teaching leave provides a sabbatical of up to 12 months for senior LASL scientific staff members, and since 1957, 123 staff members have spent leaves at about 80 institutions, including some 40 universities.
- The Summer Graduate Student Program provides summer jobs at LASL each year for about 71 graduate students, from usually about 30 universities.
- The Undergraduate Cooperative Program provides an opportunity for undergraduate students from 5 New Mexico universities to alternate six-month periods of study with six-month work phases at LASL. The program, started in 1964, currently has about 30 participants each year.
- The Youth Opportunity Campaign provides summer employment for disadvantaged high school and college students. The LASL program in 1976 employed about 150 undergraduate students from 6 area colleges or universities, and about 12 referred by local high schools to LASL's special science YOC program.
- Summer short-term employment is provided to about 30 college students, including graduate students, not included in other programs.

Postdoctoral research appointments provide an opportunity for young Ph.D.-level scientists to spend 1 or 2 years performing research at LASL. About 150 persons have received postdoctoral appointments since establishment of the program in 1963, and there are now some 30 postdoctoral appointees at the Laboratory.

- Consortia appointments are made by LASL in cooperation with Associated Western Universities, Inc., and the Northwestern College and University Association for Science (NORCUS) to provide opportunities for graduate students and faculty members to do research at the Laboratory. In any given year, about 25 individuals, representing 20 universities, take part in the program.
- Joint LASL/UNM appointments are arranged when LASL requires expertise in certain technical areas not normally represented at the Laboratory. These individuals are supported jointly by LASL and UNM.

• Adjunct faculty appointments with the University of New Mexico are held by about 30 LASL staff members who teach courses at the UNM Los Alamos Graduate Center or who serve as on-site advisors to UNM doctoral candidates at the Laboratory. As many as 10 staff members serving as advisors to candidates from other universities hold adjunct faculty appointments with those institutions.

• Outside users, appointed as guest scientists, work with Laboratory personnel in conducting research projects with LASL facilities, with the largest number of the guest scientists working at LAMPF. In 1974 the LAMPF outside users numbered more than 200 scientists from 50 universities, and now there are more than 1000 users from 337 organizations, including 115 universities represented by more than 400 individuals.

• Visiting staff members are university scientists who come to LASL for a limited time, usually to collaborate with permanent staff members. In fiscal year 1976 there were about 357 visiting staff members from 154 universities.

• The visiting scientist program is designed to encourage short visits by recognized scientific leaders to consult with LASL staff or to present technical talks, or both. More than 418 scientists from 90 universities visited the Laboratory in 1976 under this program.

• Consultants are used by the Laboratory to augment the capabilities of the staff, particularly in highly technical fields. LASL's consultants in fiscal year 1976 included about 457 university scientists from some 60 institutions.

In addition to persons involved in the specific programs, there are hundreds of formal and informal visits each year by LASL staff members to universities throughout the world to attend meetings, conduct seminars, present talks, confer with colleagues, and engage in other exchanges of information.

Videotaping Training Sessions Is Rapidly Expanding Service

About a year and a half ago, Ray Morrison, PER-5, and Ken Johnson, ISD-7, met to discuss the possibility of videotaping the Laboratory's continuing education training programs so personnel who miss sessions can view what they missed on videotape.

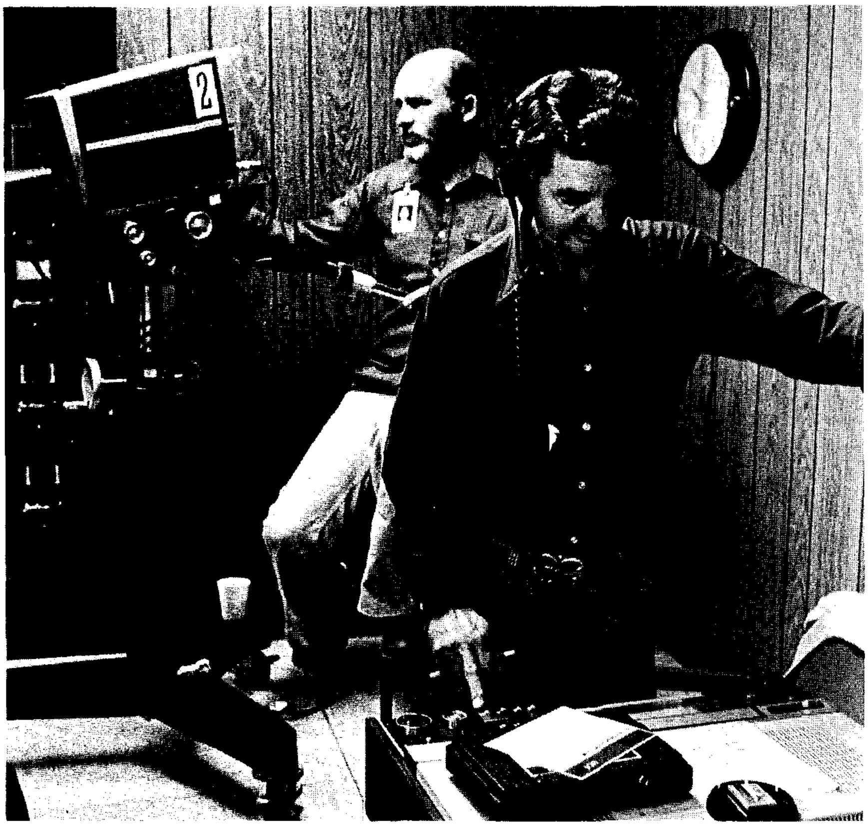
Morrison reports that in the last few months training programs in LASL policies and procedures and courses in metallurgy, chemistry, and laser technology have been videotaped. ISD-7's movie and videotape section, which had been taping the sessions, has been separated from ISD-7, and, effective January 1, 1977 became ISD-9, the motion picture and television production group, headed by Charles Barnett.

According to Morrison, increased emphasis is being placed on continuing education for Laboratory personnel to keep them current on new technology and to expose them to new areas of learning.

"LASL technicians, scientists, and support people are receptive to programs of continuing education, and demand for our services is increasing enormously," added Morrison.

Videotaping of training programs is important, not only to LASL people who don't want to

Robert Gordon, at the camera, and Jim Hudgins, at videotape recorder, both ISD-9, handle the taping of continuing education courses at LASL. Many of the classroom sessions are taped through an agreement between ISD-9 and the Laboratory's training office (PER-5).



miss out on class work, but also to other laboratories and institutions that can use LASL tapes in their training programs.

And, LASL uses tapes prepared by other laboratories or institutions to help technicians here. The Lawrence Livermore Laboratory and the Texas State Technical Institute have made tapes that are being used to help train LASL laser technicians.

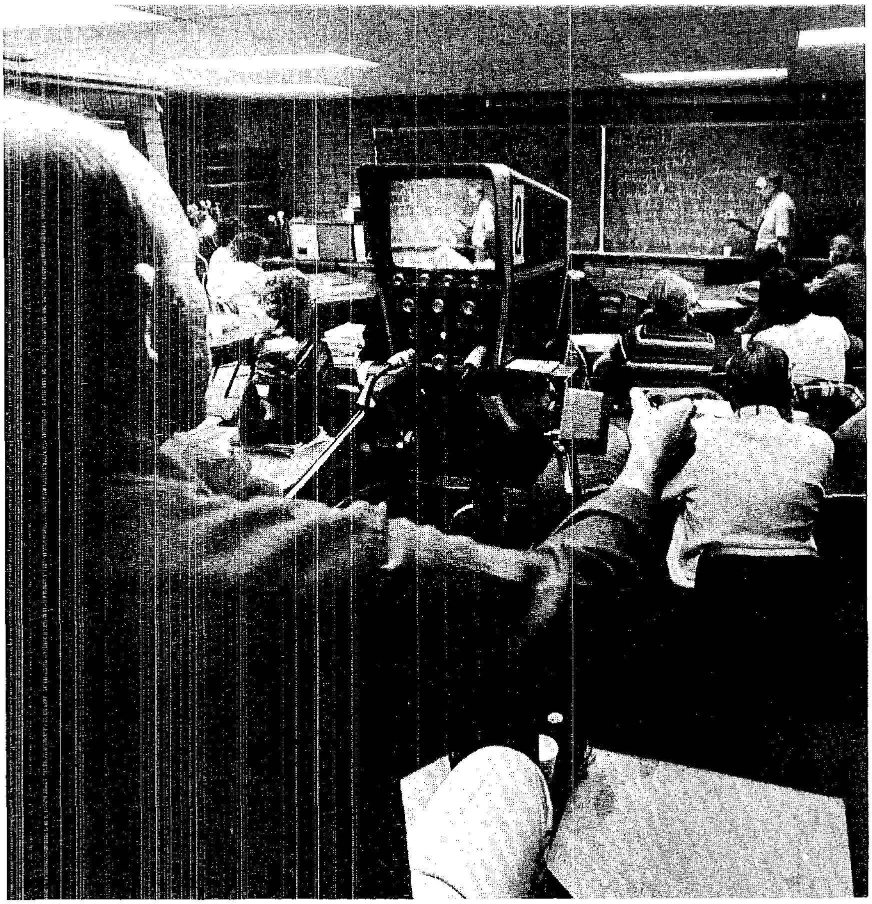
The push is to upgrade training and education at the technician level, since the technicians must know the latest information about their specialty.

ISD-9 is using a black and white studio camera on a 3-wheel dolly to videotape the sessions, with a ¾-inch tape recorder synchronized to the camera.

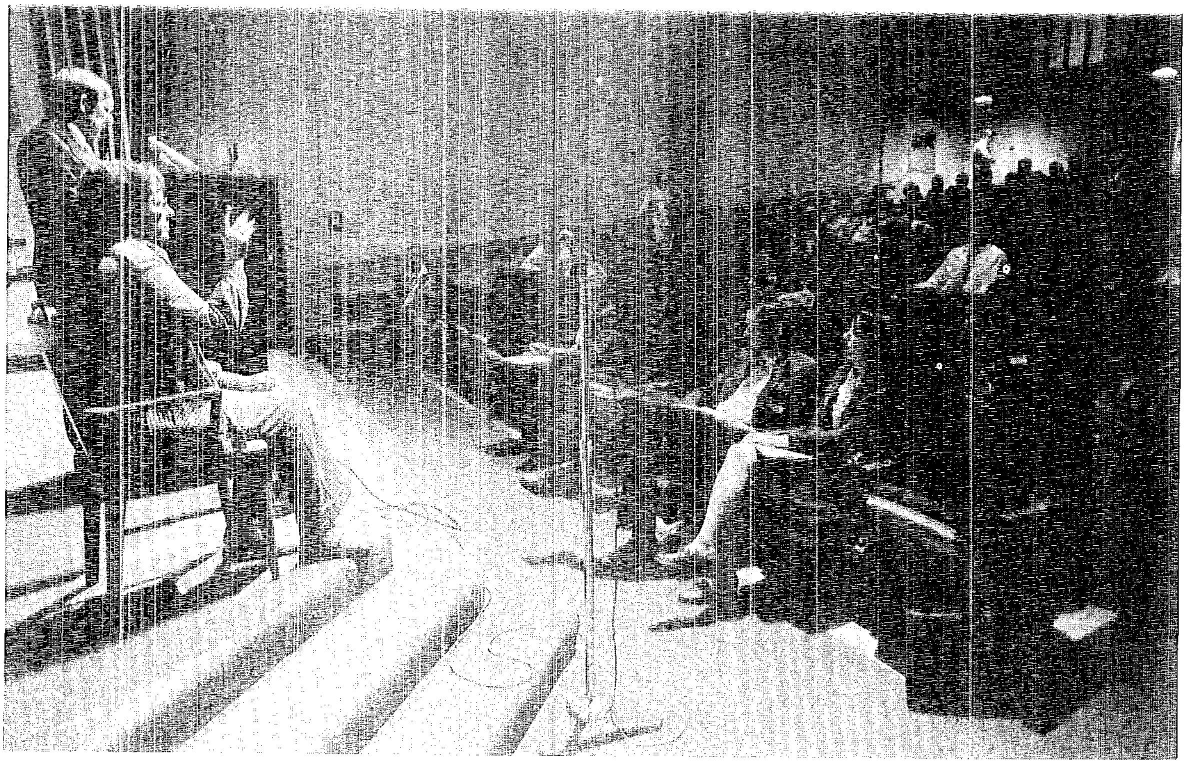
Jim Hudgins is the ISD-9 television director for videotaping the sessions, and Bob Wellnitz is in charge of sound. Other crew members are Robert Gordon and Fred Baker.

"We cannot at present videotape all training programs being conducted at LASL," said Morrison. "We are beginning to get more people and equipment, however, and are becoming better able to handle the increasing requests for videotaping various training sessions and courses," added Barnett.

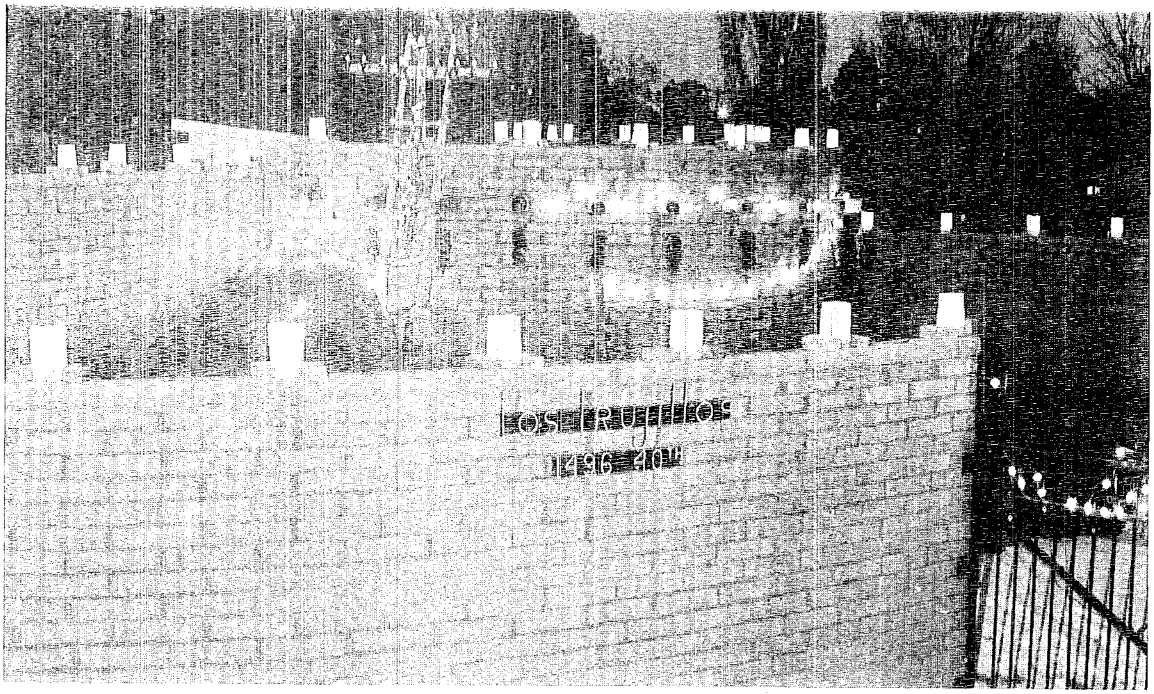
Persons who miss a videotaped training session can call Helen Trout at the training office (PER-5) to view the playback of the session. After a course has been completed, the tapes will be placed in ISD-4's report library for use by those interested in the subject matter.



In the top photo, Gordon follows the movements of Clifford Keizer of the New Mexico Institute of Mining and Technology at Socorro as he lectures LASL personnel about modern chemical technology, a course in the continuing education program at the Laboratory. LASL employees, right, listen to Keizer, as Gordon and Hudgins tape the session.



Margaret Bowman interprets the remarks of Don Randolph, ISD-7, for Don Bradford, C-6, who was deafened because of a childhood disease. Bradford, sitting several rows from the front and not visible in this photograph, was attending an ERDA contractors micrographics symposium, and through the efforts of Bowman, wife of Allen Bowman of CMB-3, he was able to know what was said by speakers at the symposium. Margaret learned sign language and finger spelling as a child because her parents were deaf.



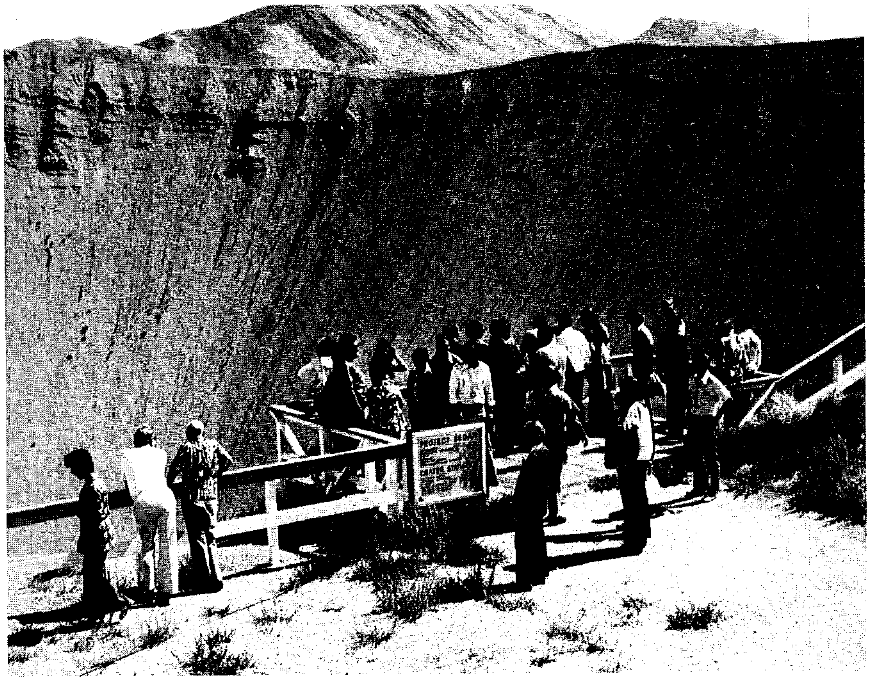
Mr. and Mrs. Joe W. Trujillo decorated the side yard of their home for the holiday season, using traditional luminarias on top of the fence. They also attached lights to wood fashioned to form a cross. The Trujillos are employed by ERDA.

Photo Shorts

Toni Flores and Lillian Lopez, both R-5, examine huge squash plants covering a large area of ground near one of the buildings at Pajarito Site. The massive plants spread from two small ones which were carefully nurtured by people at the site this fall.

Recent heavy snowfalls serve as a backdrop for these deer, photographed near the Mountain Bell Telephone building on Trinity Drive. The animals seemed unafraid of passing cars and photographer Bill Jack Rodgers.

LASL Wives, Dependents Tour NTS



Wives and dependents of LASL employees visited the Sedan Crater at Nevada Test Site as part of their day-long tour.

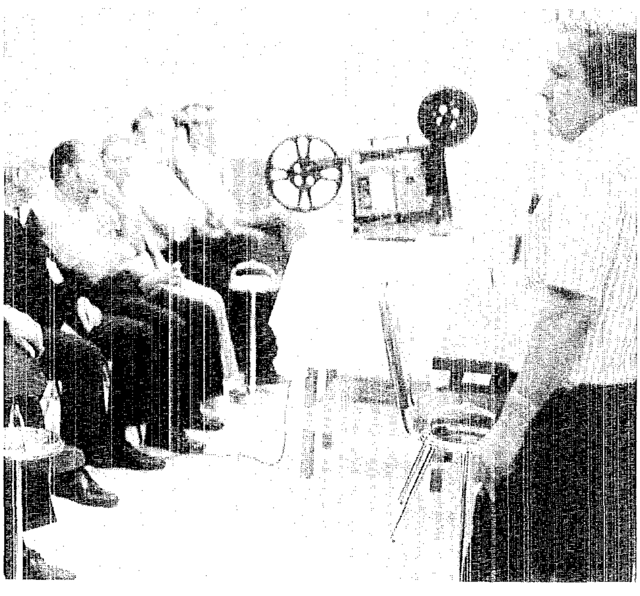
About 70 dependents and wives of Los Alamos Scientific Laboratory personnel toured the Nevada Test Site on September 27.

Traveling in 2 buses, the tour participants visited Mercury, Frenchman Flat, CP-1, LASL Test Area 3, a LASL ground zero location, Sedan Crater and T-Tunnel. The group ate lunch at Area 12 cafeteria.

The tour commenced early in the morning, and after more than 300 miles of sightseeing, concluded with a return trip to Las Vegas about 6 p.m. Bob Beiler, J-3 group leader, and Don Collins, J-3 alternate group leader, coordinated tour activities.

The tour group leaves the train after a trip into an Area 12 tunnel that holds containment structures used in explosives tests.

A tower containing equipment to be lowered into a test hole (top right) was one of the stops on the tour for the LASL group. In the photo at right, the dependents heard talks by LASL employees at Nevada Test Site, and saw a film of what happens to the surface after an underground nuclear detonation. The visitors, bottom right, observed another crater created after an underground explosion. Below, Bob Beiler, J-3 group leader and organizer of the wives and dependents tour of NTS, conducts a question and answer period at the Test Site's Control Point 1, center of test operations.



In The West Indies

Story of a Volcano

Most people probably visualize a volcanic eruption as an awesome force spilling across the pages of a novel about the South Pacific, or maybe it is some spectacular photography seen on television or in the movies.

But to a group of Los Alamos Scientific Laboratory scientists, the activity of La Soufriere volcano excited all the senses. It was real.

La Soufriere, on the island of Guadeloupe, is one of 17 active volcanoes in the West Indies. In late spring and early summer of 1976, there were several steam and ash eruptions and a pronounced increase in the number of earthquakes associated with the volcano. This caused concern for the safety of 70,000 residents of the nearby towns of Basse-Terre, St. Claude and Trois Rivieres, located on the slopes of the volcano.

Shown in this view from the southwest of La Soufriere volcano are the cities of Basse-Terre and St. Claude. The east and south sides of the volcano are covered by clouds, and steam jets and ground-hugging steam are visible on the northwest slopes.

These areas were evacuated in early summer, primarily because of the increased seismic and eruption activity, and because La Soufriere volcano is somewhat similar geologically to Mt. Pelee, an active volcano on the nearby island of Martinique. The ash-blast eruption of Mt. Pelee in 1902 destroyed the city of St. Pierre.

The evacuation created hardships for obvious reasons, but in addition, the crisis occurred at banana harvest time and resulted in a particularly delicate political and economic problem, one in which reliable means of predicting volcanic activity became very important.

A multidisciplinary team of French scientists from the University of Paris conducted scientific studies of La Soufriere under Claude J. Allegre. Allegre, who is director of the Institute of Geophysics at the University of Paris, is planning to present a colloquium at LASL in March on the work at his Institute. French research included studies of the distribution, magnitude, and characteristics of volcano-related earthquakes, variations in the earth's magnetic field near the volcano, analyses of volcanic gas compositions, geologic mapping of the summit of the volcano, and tiltmeter studies.

In late summer, LASL scientists received a formal invitation from French authorities to assist in predictive and scientific studies of La Soufriere. Research plans were quickly formulated, and 3 LASL and EG&G personnel departed for Guadeloupe in late August. The LASL effort was supported by monies from ERDA's Division of Physical Research, NASA's Office of Planetary Geology Programs and from the State Department's Office of Disaster Aid.

Almost 20 LASL and EG&G people became involved in the volcano studies over the next 2 months. They include Grant Heiken, Francis West, Thomas McGetchin, Bruce Crowe, Kenneth Wohletz, and John Eichelberger, all Q-21; B. C. Lyon, Arlin Givens, and Alex Salazar, J-1; Emil Fred Homuth, J-13, Jimmie Martin, J-16, Harold Fishbine, J-10, C. R. Robertson, J-DO, Donald Bartram, J-14, Robert Peterson, J-DOT, Paul Guthals and William Sedlacek, both CNC-11, Jurgen Kienle, a visiting staff member in Q-21 from the Geophysical Institute of the University of Alaska, and Bill Lockyer and Charles Lewis, both EG&G.

Bruce Crowe, Q-21, standing, and Donald Bartram, J-14, install a sequence camera in an abandoned house on the southern flank of La Soufriere.

LASL scientific experiments at La Soufriere centered around tiltmeter studies, eruption photography, and analyses of ash samples from eruptions. Tiltmeters are sensitive instruments which detect tilting of the ground surface caused by inflation of a volcano as magma (molten rock) or gases rise to shallow levels. These instruments are capable of measuring vertical movement of less than 1 millimeter over a distance of 1 kilometer. Tilt events commonly precede major volcanic activity by a period of weeks to months. These events, if recognized, can provide a means of predicting eruptions.

While the LASL tiltmeters at La Soufriere did not prove useful for predictive purposes, their data, when analyzed in conjunction with results from the other experiments should prove useful in analyses of eruption mechanics.

A continuously operated sequence camera and several handheld cameras provided the data base for photographic experiments. Detailed documentation was obtained for several eruptions, and the photographs are being carefully studied for information on eruption mechanics.

LASL analyses of ash samples indicated that the ejected particles were old, hydrothermally altered and pulverized lava. No new magma was involved in the eruptions, which suggested a lower probability of future major activity.

Photographs Taken By LASL Team Members On Guadeloupe

Magma never reached the summit of the volcano, but violent hydrothermal activity resulted in the ejection of steam and mud in outbursts lasting from a few minutes to a few hours. One such eruption which occurred on October 4 is shown in photographs on pages 20 through 23. During this eruption, the summit area was bombarded with blocks of older rock from sand-size to large boulders, and warm mud flowed down the flanks of the volcano.

Large areas downwind from the summit were coated with grey mud from eruption clouds, and sulfurous gases made the scientists aware of the volcano's name. Between eruptions, steam continued

The summit parking lot, about 500 meters (1,500 feet) from the volcano summit, is coated with fresh ash from the eruption of October 10. French scientists and support personnel stand beside the vehicles, which are pointed downhill with doors open and the keys in the ignition.

to flow from the line of vents across the summit dome.

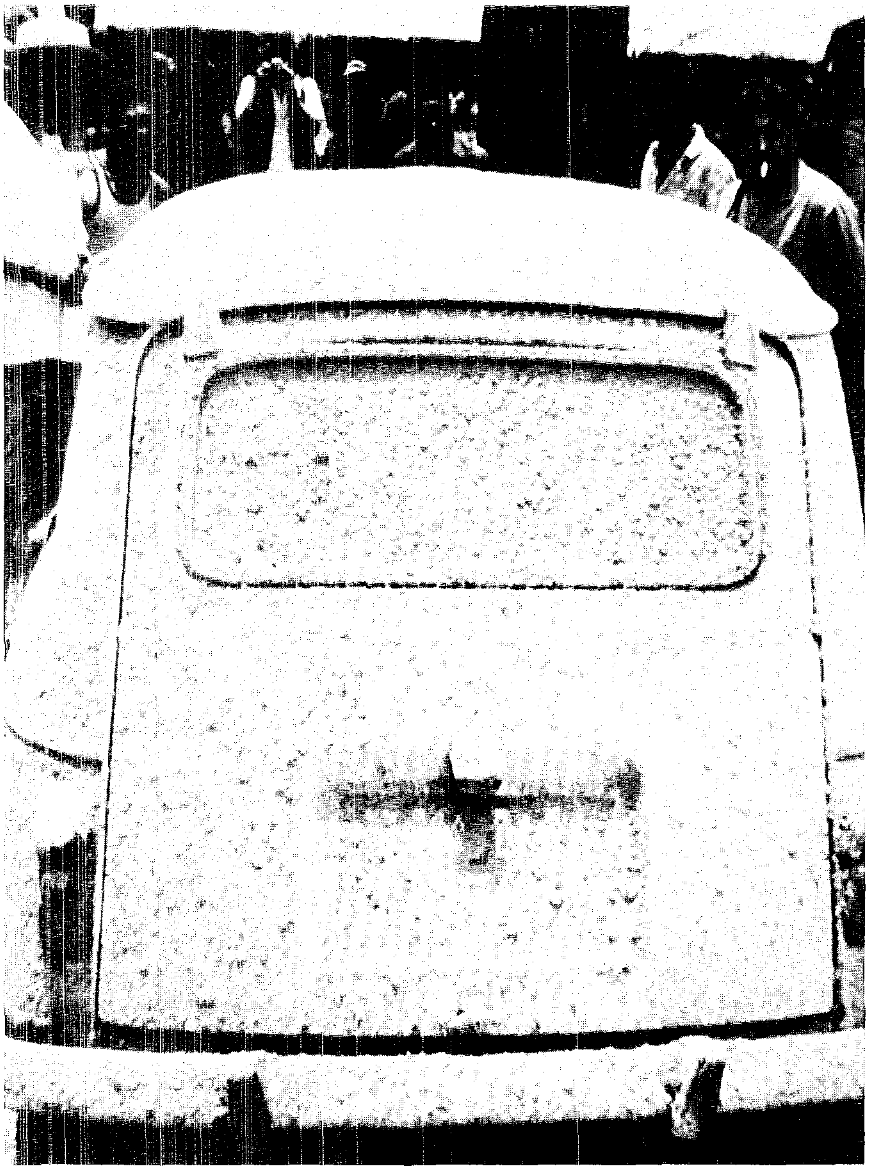
The 300-year-old Fort St. Charles in Basse-Terre served as headquarters for field laboratories and a logistical base for work on the volcano. Since the city had been evacuated, the fort was the only location occupied by humans. The city had been left to dogs, cats, goats, and pigs.

Scientists were housed in the safely distant city of Gosier, or on Isles des Saintes, 3 small islands just off the coast of Guadeloupe near La Soufriere. No one, other than a caretaker group, was allowed to spend the night in the fort. Groups going to the summit were outfitted with hard hats, gas masks, heavy raincoats, and radios. Cars were parked below the summit pointed downhill with doors open. After the experience of August 30, when 12 people were caught in a summit eruption (fortunately, none was seriously injured), these precautions were required by French authorities before working on the volcano.

Active participation of LASL personnel in the volcano study ended in late October. Four of the 6 LASL tiltmeters were left with the French to operate as they saw fit, and data and ash sample analysis is continuing at LASL.

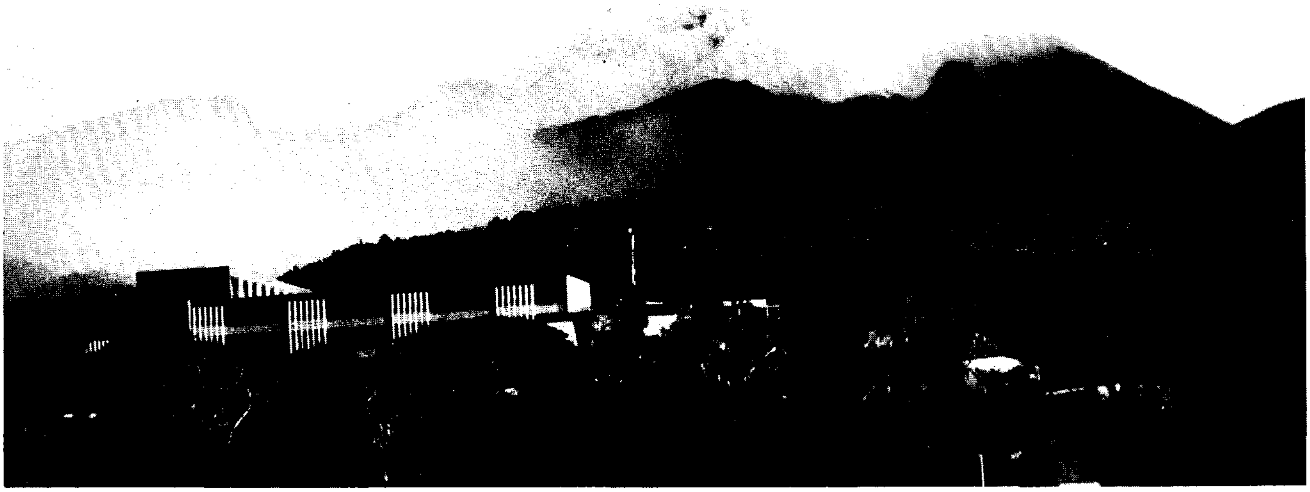
Hydrothermal steaming continues at La Soufriere, but with much less vigor. The residents were allowed to return to their homes in early November, but are aware that evacuation may be necessary again if the activity increases.

The collective goal for the scientists studying La Soufriere and for volcanological studies elsewhere is to be able to provide authorities with prior notice of an impending volcanic eruption on a time scale consistent with required actions such as evacuation of residents. Continuing research on active volcanoes similar to the LASL studies at La Soufriere provide important steps toward making this goal technically feasible.



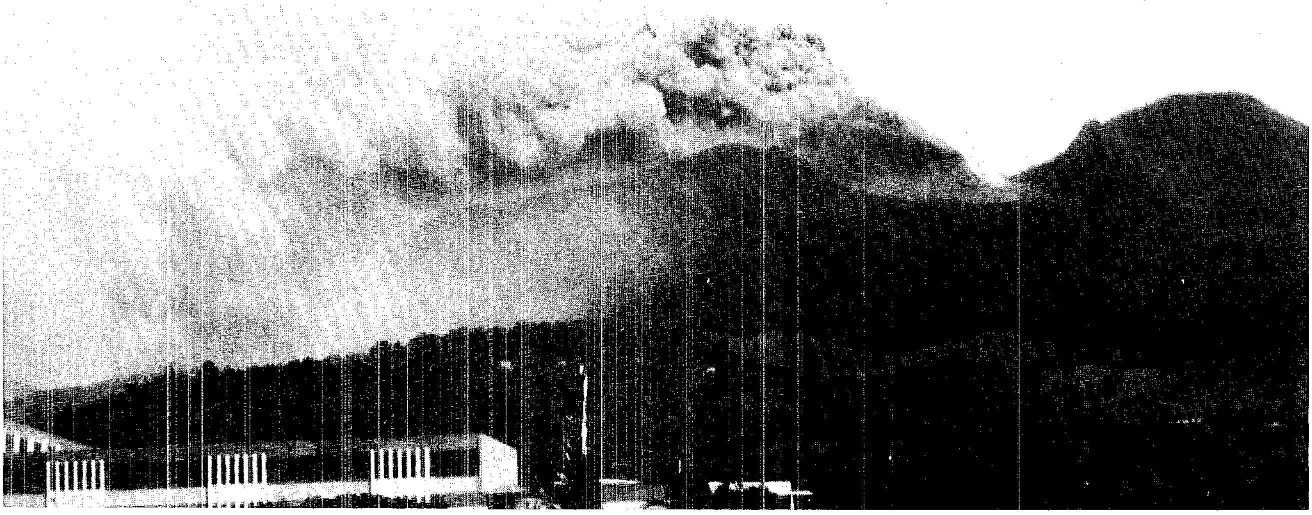
An automobile, caught in the eruption of August 30, is coated with fine-grained muddy volcanic ejecta.

October 4 Eruption Sequence, La Soufriere Volcano

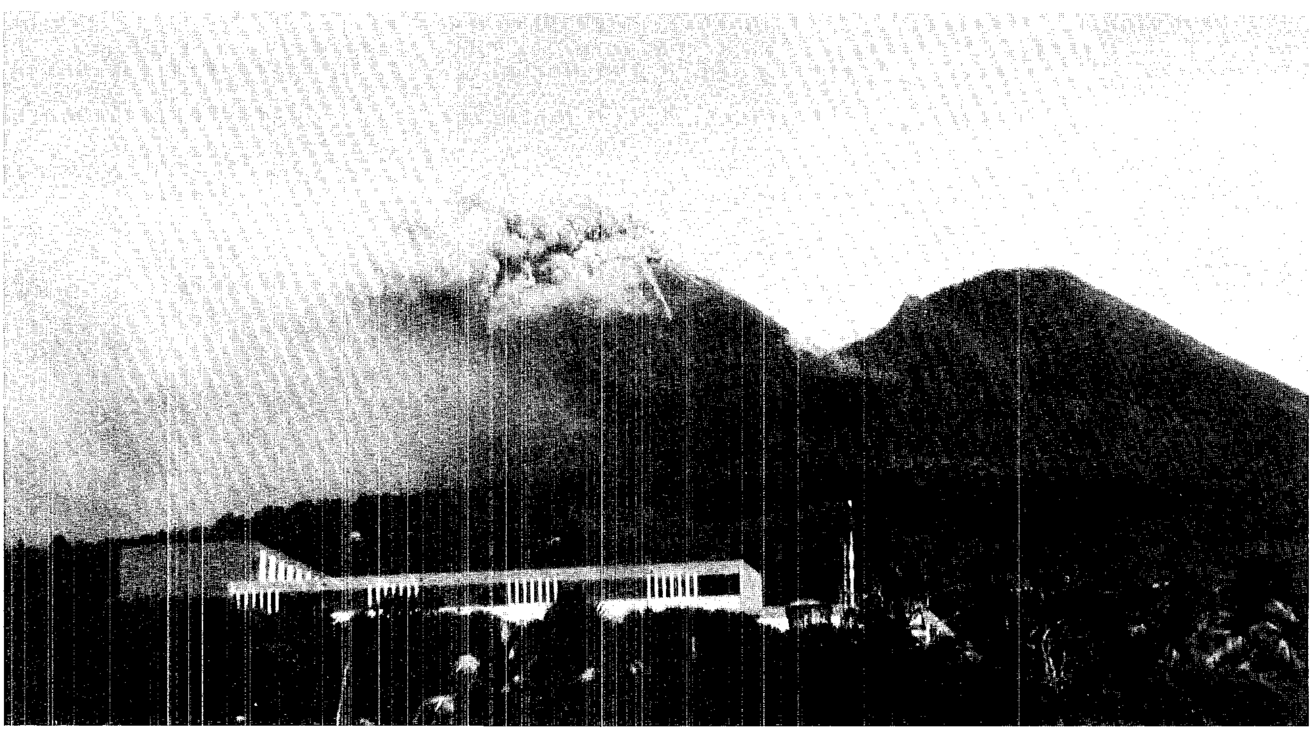


A. 10:30 EDT—Initiation of eruptive event marked by a major increase in steam output from south part of summit rift zone of volcano.

B. 10:50 EDT—First appearance of ash in steam clouds. Steam and ash-bearing clouds jetted to height of approximately 100 meters (320 feet) and were blown west by prevailing winds.

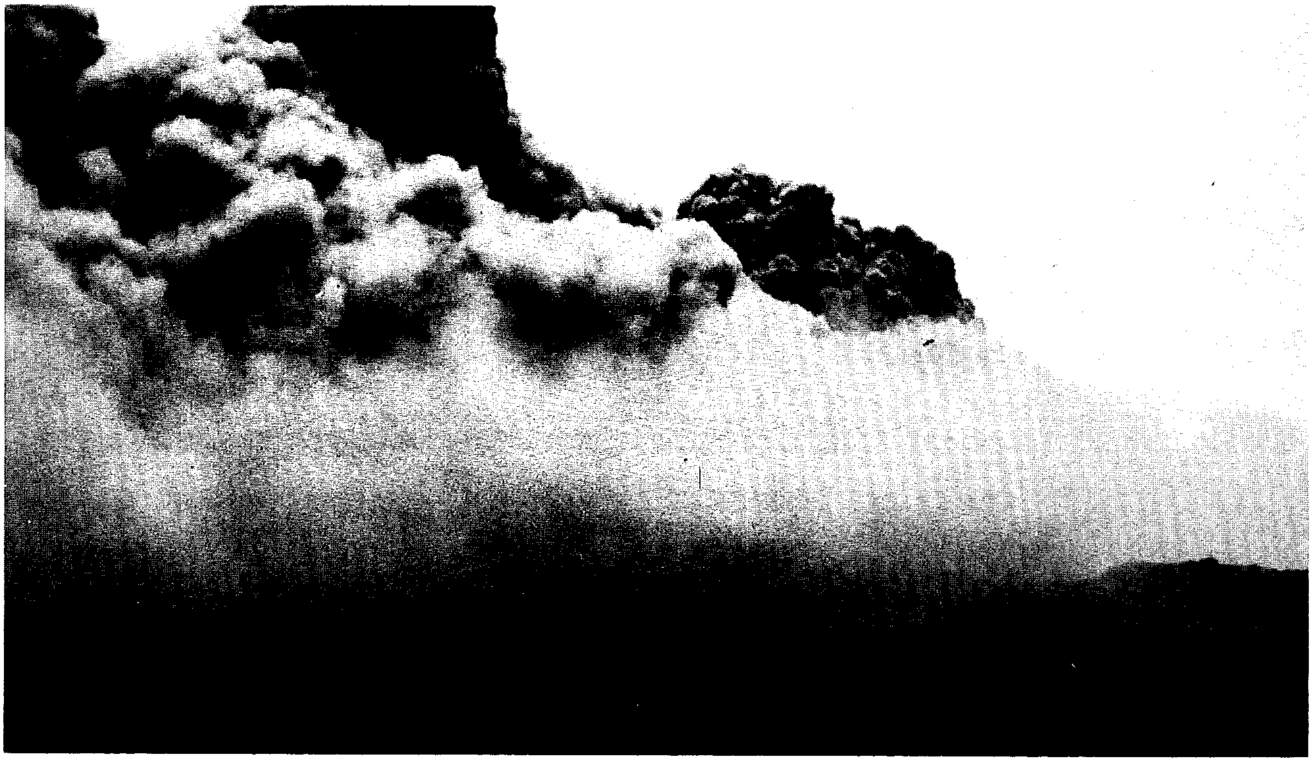


C. 11:50 EDT—Approximate development of ash column during eruptive activity. Ash cloud jetted to about 300 meters (1,000 feet) above vent and expanded to more than 650 meters (2,000 feet) above the ground surface 1,000 meters to 2,000 meters (3,000 to 6,000 feet) downwind of vent.

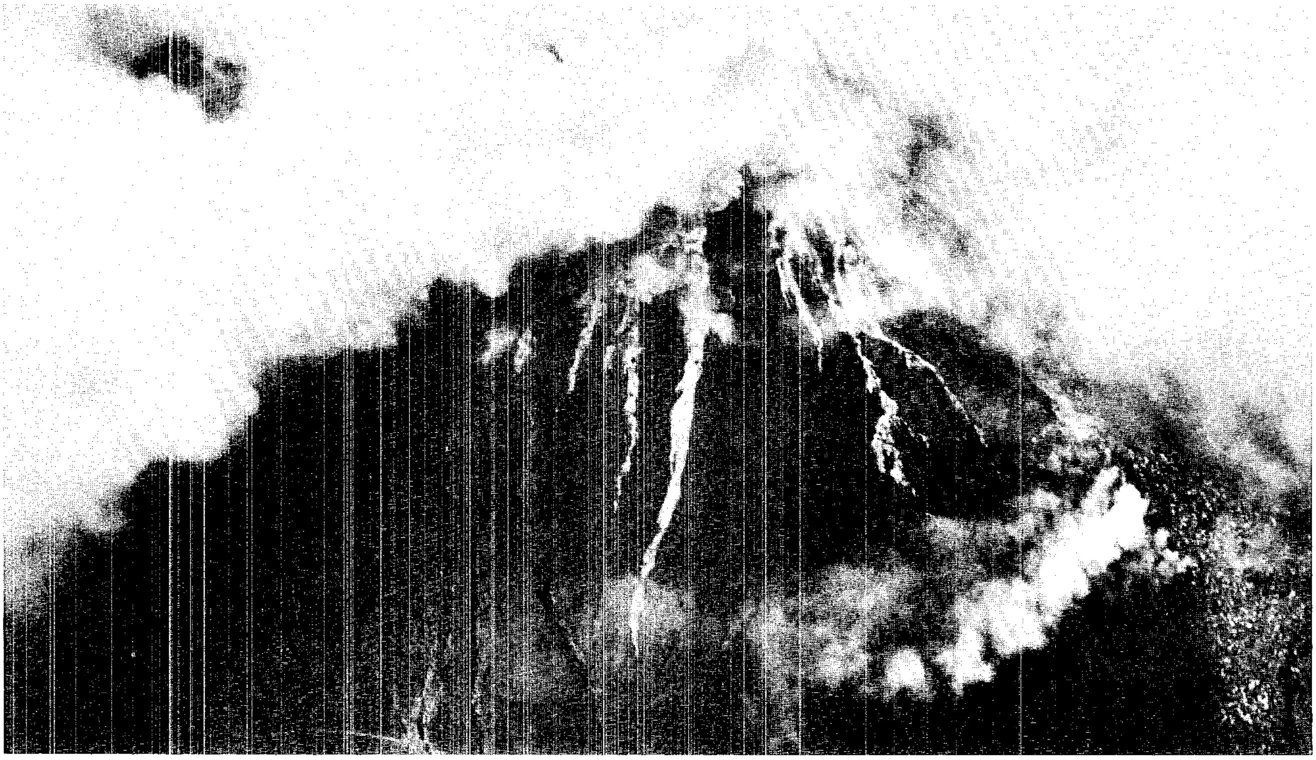


D. 12:40 EDT—Formation of volcanic mudflows down the southwest slopes of the summit of the volcano during latter stages of activity.

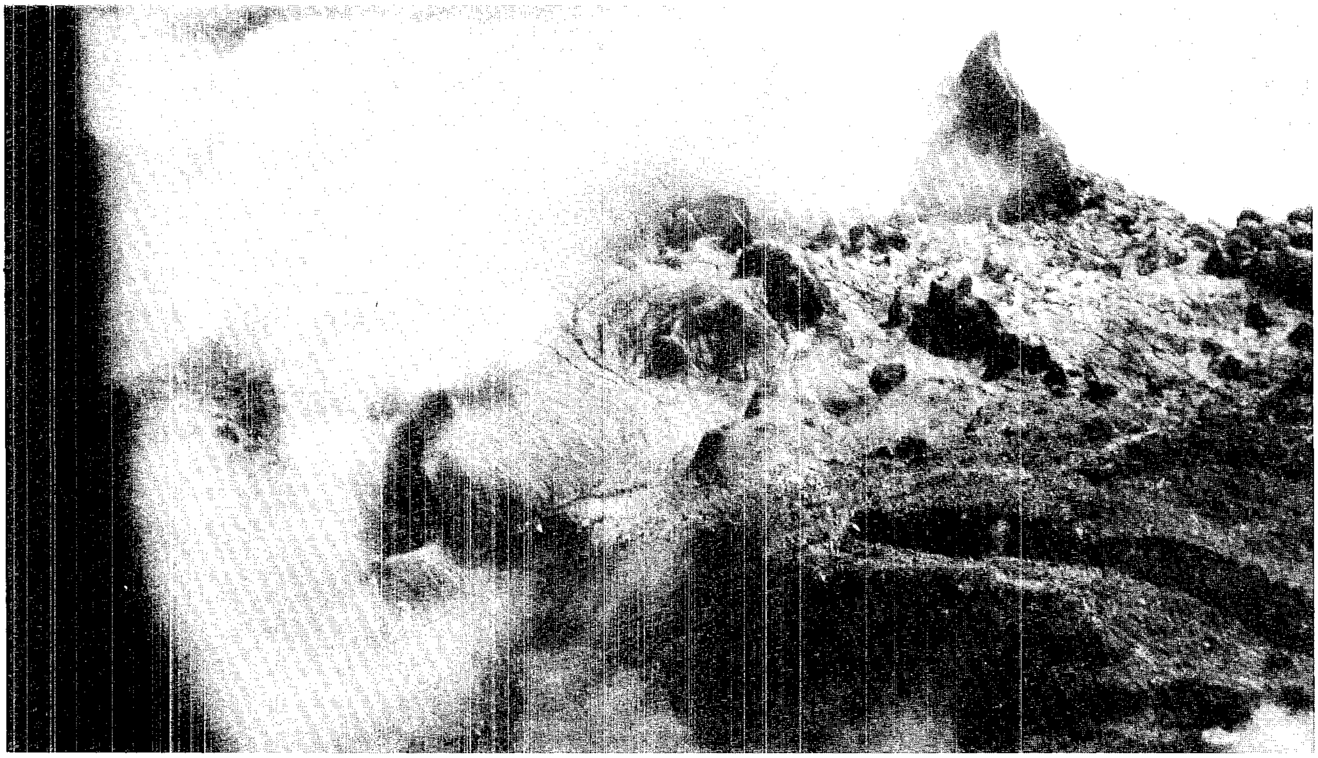
E. View along street in St. Claude of La Soufriere volcano and eruption column of October 4. St. Claude was one of several cities evacuated during the volcanic activity.



F. Telephoto (135mm lens) view of ash-laden clouds jetting directly above the vent. *Taken during beginning of activity on October 4.*



G. View of volcanic mud flows that developed on southwest slopes of summit dome. The photograph was taken from a French helicopter at about 3:30 p.m.



H. View from helicopter of the summit of La Soufriere.

Nuclear Industry Safety Record Is Emphasized

The public information office at Lawrence Livermore Laboratory recently sent to ISD-1 a letter containing statistics on the radiation safety record of the atomic energy establishment.

The letter presents the following information, taken from a government publication, *Operational Accidents and Radiation Exposure Experience Within the USAEC*:

"From 1942, when the Manhattan Project began, to 1975, when the AEC went out of business, the atomic energy operations community experienced 10,086 disabling (lost-time) accidents of all kinds—burns, electrical shocks, falls, helicopter crashes, etc. Of these, 41 were due to radiation exposure—0.4 per cent of the total. In other words, spend all the extra money you want on radiation safety, even eliminate radiation accidents altogether, and you haven't even affected 99.6 per cent of those accidents. Of the 41 lost-time radiation accidents between 1942 and 1975, all but 7 occurred before 1960."

The letter also states that the atomic energy establishment's overall accident record is more than 3 times better than general industry's during the same period: 2.8 disabling accidents per million work hours for the atomic energy industry, compared to 8.8 per million work hours for industry in general.

Cowan Honored

Robert D. Cowan, T-4, has been elected a Fellow of the Optical Society of America. He has been in the Laboratory's T-Division since 1951.

10 *years ago in los alamos*

Culled from the January, 1967 Files
of The Atom and The Los Alamos Monitor, by Robert Y. Porton

Appointment

LASL staff member William R. Stratton has been appointed by AEC Chairman Glenn T. Seaborg to serve on the Advisory Committee on Reactor Safeguards. This committee advises the Atomic Energy Commission in regard to the hazards of proposed or existing reactor facilities and the adequacy of proposed reactor safety standards.

Good Buy!

The "bargain hunters" of the Supply and Property Department have done it again. A $300,000-plus value has been obtained for less than $5,000. The purchase will enable the Lab to increase the hydrogen storage capacity of N-Division by more than 50 per cent—thanks to some surplus Air Force missile fuel tanks. SP found the tanks in South Dakota at a Titan-1 missile complex. Because the site was being dismantled much of the equipment was offered as surplus. The only cost to LASL was the transportation charges from South Dakota to Los Alamos.

Seminar

The Los Alamos Scientific Laboratory will host a four-day optical work shop here next week. The meeting is under the joint sponsorship of the AEC and the Department of Defense. More than 70 participants from laboratories, military installations and universities are expected to attend. Among these are Dr. Hans Bethe of Cornell University, Dr. Kenneth Watson, University of California, Berkeley; plus Lt. Gen. A. W. Betts, Chief Research and Development, Department of the Army. One of the purposes of the work shop is to discuss photographic and spectroscopic data obtained from high altitude nuclear detonations before the banning of atmospheric tests.

J. Harrison, second from left, British Defence Staff in Washington, D.C., visited LASL recently, and talked with, from left, Duncan MacDougall, former associate director for weapons, Robert Thorn, associate director for weapons, and Laboratory Director Harold Agnew.

Among Our Guests

Robert Thorn, second from left, shakes hands with George Ashworth, who is on the staff of the Arms Control Subcommittee of the Senate Foreign Relations Committee. With Ashworth is Leonard Kojm, far right, of the Office of Congressional Relations, ERDA Headquarters. Also greeting the Washington visitors are, left, Harry Hoyt, assistant director for weapon planning, and, center, Jim McNally, TD-7.

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